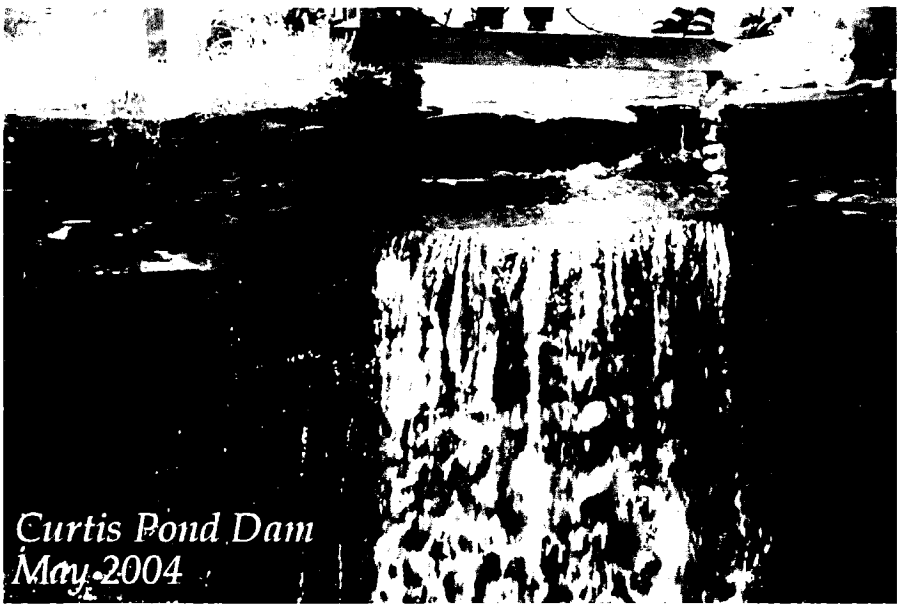
BILL POWELL

CALAIS DAM TASK FORCE
FINAL REPORT TO THE SELECTBOARD
FEBRUARY 15, 2005



TO: Calais Selectboard DATE: February 15, 2005

FROM: Calais Dams Task Force

The Calais Dams Task Force hereby submits 6 copies of the Final Report as approved on February 15, 2005.

Respectfully submitted:

Davis Cherington, Chair
Denise Wheeler, Vice Chair
J.C. Myers, Recorder
Barry Bernstein
John Brabant
Gary Root
Warner Shedd

Motion as passed by the Selectboard on April 12, 2004

Paul Hannan moves that a Task Force on Calais Dams be created with the following make-up and charge:

Make-up:
7 citizen members with a liaison Selectboard member as an eighth, non-voting participant. Two of the members shall have been active in the ongoing efforts to repair the Curtis Pond Dam. The remaining members shall be from outside the Curtis Pond/Maple Corners area.

Charge:
While focusing on recommending a solution to the Curtis Pond dam situation, the Task Force shall examine the following items with the goal of developing a town policy and evaluation criteria for addressing privately owned dams in Calais for adoption/action on or before November 2, 2004:

- Secure an inventory of all privately owned dams in Calais with whatever structural evaluation information can be readily obtained without significant town expenditure
- Identify various alternatives to private dam ownership and examine pros and cons of both the alternatives and continued private ownership
- Examine various public and private funding mechanisms and authority for repair of failing dams and their availability/appropriateness for different ownership alternatives
- In the case of the Curtis Pond dam, consider whether satisfactory, less expensive alternatives to the currently engineered repair design exist
- Other relevant issues that will aid in developing a policy

The Task Force shall elect a chair, warn meetings and agenda, keep minutes and report regularly to the Selectboard. This Task Force shall cease to exist on or before November 2, 3004 unless specifically extended by the Selectboard.

Members appointed to the Task Force by the Selectboard on April 12, 2004

Barry Bernstein
John Brabant
Davis Cherington
J.C. Myers
Gary Root
Warner Shedd
Denise Wheeler

Jack Russell – facilitator (non-voting)
Paul Hannan – Selectboard liaison (non-voting)

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CDTF
TASK FORCE REPORT
February 15, 2005

Summary:

The Calais Dams Task Force (TF) hereby forwards its recommendations to the Calais Selectboard (SB) in accordance with the SB's charge of April 2004. The TF has held 14 two-hour meetings over the past nine months

The TF could not reach consensus on the key issue of financial fairness, i.e., which bond amortization option would be the most fair and equitable. However, the report does make some specific recommendations in the other key areas. With the TF report in hand, the SB is now in a position to act decisively and without delay. **All members of the task force agree that any permanent lowering of the water level of Curtis Pond is unacceptable. A majority (5 yeas, 2 nays) of the TF recommends town ownership and responsibility with the formation of a shoreline special assessment district. (Section 5)**

Background:

Since the 1960's, the structural condition of the Curtis Pond (CP) Dam has raised concern. Heavy rains at one point led to an emergency sandbagging operation to shore up the flanks of the dam. The Dam Safety Division of the Agency of Natural Resources (ANR) periodically has expressed its statutorily authorized concern as the State's regulator.

Over the past four years, feeling a growing sense of urgency, several citizens repeatedly brought CP Dam safety concerns to the Calais Selectboard (SB). The SB was reluctant to get involved, since the dam is privately owned (by parties originally unknown to the SB.)

Although 55 (52 individual parcels, 2 town owned parcels, and 1 state owned parcel) property owners front on CP, there is no constituted "Pond Association" that speaks for the majority of the frontage owners. Seventy-five percent of the frontage owners are non-residents. The lack of a pond association communicates to the town-wide citizenry an undertone of indifference on the part of the majority of shoreline taxpayers, the very group most directly affected by the dam's future. (Notwithstanding the above, it should be noted that there are several pond frontage owners who have been strong and vocal advocates for the pond's water quality and/or repair of the dam.)

Some frontage owners have long complained that their property is over assessed. Recent market sales on the Pond contradict these complaints.

About two years ago, a group of citizens around Curtis Pond and in the Maple Corner vicinity believed that the Curtis Pond Dam (CPD) had recently become even more unstable and represented a threat to the future of CP and the downstream property owners. This group formed an ad hoc committee and facilitated state funding for an engineering study.

Meanwhile, the State undertook a title search to determine the dam's owner. The chain of title (now on file at the Calais Town Clerk's office) led to ownership by Candace Beardsley & John E. Fothergill via Candace's Parker forebears. Candace and Jeff have disclaimed title; subsequently, Candace's father has also disclaimed title. The title now rests with the heirs of Elgin Mann or, effectively, in limbo.

Via ANR funding, the ad hoc committee contracted with DuBois & King (DB&K) to evaluate the dam and to recommend a course of action. DB&K's report recommends a steel-reinforced concrete replacement dam to be built behind the existing stone dam.

The committee explored possible grants for the recommended work. It soon learned that, lacking a legally determined and willing owner, no person(s) or entity exists that is eligible for any type of financial grant or assistance.

The ad hoc committee brought its work to the SB and to the 2004 March Town Meeting in the form of a written report. The public discussion at the March 2004, town meeting led the SB to appoint monitors to keep track of the dam's condition and to trigger a flood warning alert network in the event dam failure appeared imminent.

The SB also voted to establish the Calais Dam Task Force (CDTF). In April 2004, the SB appointed a seven-member Task Force (TF): two people from the west side of town, Davis Cherington of Worcester Road and J. C. Myers of West County Road; two people from the center of town, John Brabant of Singleton Road and Denise Wheeler of Bayne Comolli Road; and three from the east side of town, Gary Root of Route 14, Barry Bernstein of Bliss Road, and Warner Shedd of Sand Hill Road. Davis Cherington was elected Chair, Denise Wheeler, Vice-Chair, and J.C. Myers, Recorder. Paul Hannan was appointed Selectboard liasson.

The SB adopted a Charge listing five areas it expected the Task Force (TF) to explore (see Exhibit C).

CHARGE:

While focusing on recommending a solution to the CPD situation, the TF shall examine the following items with the goal of developing a town policy and evaluation criteria for addressing privately owned dams in Calais for adoption/action on or before November 2, 2004.

#1. Secure an inventory of all privately owned dams in Calais with whatever structural evaluation information can be readily obtained without significant town expenditure.

The Task Force listed all dams in town, the owners, and the state's assessment (Section 4) of the condition of the dams.

There are 10 dams or dam sites in town:

1. Two on Moscow Woods Road were breached many years ago.
2. Elmslie's Dam was rebuilt in 1988, and there is no public access.
3. Weedon's Dam has no public access.

4. Frank Suchomel, Jr.'s Adamant dams. He has declined the state's offer to inspect them. He recently repaired all of his dam structures at his own expense.
5. Robinson Sawmill Dam (Aldrich Memorial Association) impoundment is less than 11 acres and thus is not covered by state regulations.
6. Zencey / Davis Dam in North Calais is scheduled for inspection by Steve Bushman from ANR.
7. Moscow Mill Dam, East Calais, is owned by John Risse. The impoundment is less than 11 acres, but the state will inspect it in the spring when repairs are complete.
8. Mirror Lake (#10 Pond) Dam is owned by Curtis Johnson and now or ~~formally~~ by Barbara Butler. The State has not yet inspected it on-site, but care of the spillway was discussed by Steve Bushman. It seems the spillway is almost level with the upstream bed and should be kept clear of debris; as long ago as 1969 the state recommended that the spillway remain clear.
9. Curtis Pond Dam - An estate owns the dam. It is deteriorating, but the rate and manner of failure is unknowable. The state inspects the dam monthly.

In summary, dams #1 - #8 have clearly titled owners, the owners agree that they own the dams, and none pose any threat of breaching. **The Curtis Pond dam is the sole dam which needs to be of immediate concern to the Selectboard.**

2. Identify various alternatives to private dam ownership and examine pros and cons of both the alternatives and the continued private ownership.

The TF spent a considerable amount of time exploring dam ownership and the liability associated with ownership. In the course of this discussion, the TF came to agree that increased leakage resulting in a gradual lowering of Curtis Pond's level is just as likely a future scenario as is a sudden collapse. Cabot's recent experience with West Hill Pond (much smaller than CP) is a visual case example. There, the dam's sluiceway gate failed this fall, draining a substantial percentage of the pond and leaving exposed mud flats around the Pond's perimeter.

The TF concentrated on the following three ownership options for the CPD:

1. Ownership by a private group such as a Pond Landowners Association – The TF believes there is little chance of forming a cohesive group. About 75% of the property owners are not registered voters or legal residents in Calais. Without the availability of the Vermont League of Cities and Towns' (VLCT) insurance, private association liability insurance would be difficult and very expensive to obtain. Certainly any insurer will require that an engineer's dam reconstruction plan be underway with a guaranteed completion date. In short, until the Town of Calais or its duly constituted district rebuilds or replaces the dam, there is no practical way ownership can be conveyed to a private entity.

2. Ownership by a Fire District – A Fire District is a separate municipal entity within the town. Therefore, it is thought that liability coverage could be part of the town's

overall VLCT policy and would be relatively inexpensive. Once the Fire District is established, it raises and disburses all monies for district projects. Only registered Calais voters within the Fire District would be voters within the district. However, a Fire District would need several officers, essentially replicating/duplicating some existing town officer positions.

3. **Ownership by the Town of Calais – the Town, with a special assessment district, (24 V.S.A. Chapter 87 Sections 3251-3256) would bear financial and legal liability for maintenance. Insurance would be covered on the town's present policy with VLCT.**

The TF notes that ANR suggested that the Town of Calais consider establishing a sinking fund for maintenance and future replacement of the dam in 75 years.

In order to acquire ownership of the dam, the Town will need to file notice to "quiet title." The Heisses and the Millers own the land underlying and adjacent to the dam. Therefore that property under and immediately surrounding the dam may need to be secured via easement or fee simple purchase in order for work on the dam to take place without trespass.

4. In the case of the Curtis Pond Dam, consider whether satisfactory, less expensive alternatives to the currently engineered repair design exist.

The TF first reviewed all available material that had been collected by the previous ad hoc Dam Committee. An indexed notebook was prepared and all documents were distributed to the TF.

Morris Root of Springfield, Vermont, a certified engineer, came to look at Curtis Pond Dam. He was hired by the TF through ANR to review the data from the DB&K report and to prepare a matrix of six options ranging from placing boulders on the downstream side of the dam to the new concrete dam as designed by DB&K. .

Jeff Tucker from DB&K spent one evening with the TF answering questions about the DB&K proposal, which had been contracted for by ANR at the urging of the previous ad hoc Curtis Pond Dam Committee.

Steve Bushman, State Dam Engineer with ANR's Facilities Engineering Division, met with the TF and answered questions related to permitting, backfill materials, etc.

The TF narrowed the six engineering options down to two.

The TF recommends either the Morris Root proposed rebuild option (Section 2) or the DB&K concrete dam option (Section 3).

COST CONSIDERATIONS

The DB&K Concrete option was quoted at $228,044, 1 year ago. The cost of building materials (especially concrete and steel) has risen since then and will continue to be volatile. The cost of this option must be viewed in that context, and an update would be necessary before this option could be considered.
It must be noted that the concrete dam option will not repair the existing dam. Rather, it will place a new dam a few feet upstream of the stone dam. The existing dam will no longer be required to hold back water. It will not be visually compromised by the construction. But it will continue to be affected by time and frost, and its long-term appearance/stability will depend on periodic maintenance. This will be an aesthetic and financial issue, not a structural issue.
At the end of the life of the concrete dam decommissioning costs will be primarily the removal of the broken concrete and twisted, rusted reinforcing steel.

The Morris Root Rebuild option (received 6 months ago) is estimated at $175,588, which includes a contingency where uncertainties were seen.(Further core samplings and site evaluations are necessary before the final engineering plans can be written.) Then quotes for the actual work could be solicited. This estimate must be viewed as a loose estimate because of its preliminary nature. The Rebuild option would re-construct the dam just as it was done 100+ years ago. It will re-use the present stone, give more attention to the quality of the grade of the fill material (un-graded fill material is the likely cause of the current dam's seepage) and lengthen and deepen the spillway.
At the end of the life of the rebuilt dam decommissioning costs will be less as rebuilding the dam will always re-use the dam's materials (stone and graded fill).

Both the Morris Root Rebuild and DB&K Concrete options use a temporary coffer dam to control the water during construction at an approximate cost of $25,000 (ANR generally looks upon temporary draw-downs with disfavor because it believes the environmental costs exceed the cost savings). The Task Force is not opposed to a draw-down if a permit can be obtained without undue time and expense.

Both the DB&K Concrete and the Morris Root Rebuild proposals have a stated life expectancy of 75± years, and no de-commissioning cost has been included for when the next rebuild of the dam comes around. Both proposals leave the future replacement up to those who may wish to save Curtis Pond in 2080.

The life expectancy of both options is similar, so the cost difference of $52,456 (20%) is something that must be considered along other issues when arriving at a final decision.

The DB&K Concrete option:

- is less able to protect the aesthetics of one of our scenic treasures
- uses a large amount of material whose cost and availability is now and will continue to be unpredictable due to industrial regulation and market forces
- is more expensive to begin with as a total project
- will be more expensive to maintain over the long run due to de-commissioning costs every re-build cycle

5. Examine various public and private funding mechanisms and authority for repair of failing dams and their availability/appropriateness for different ownership alternatives.

Since private funding and funding via grants depend on a known and willing dam owner, such funding sources were not explored in regard to the CPD. Any private group or association which accepts ownership of the dam from the Town would have to seek its own funding via grants, fund raising, or its own pocket(s). It would also have to buy liability insurance as a private organization, rather than as a municipality, which is more costly and difficult to obtain.

If a Fire District is formed to own and operate the dam, then the Fire District would be empowered to specify assessment allocations within the District. The District's liability insurance likely could be carried via the Vermont League of Cities and Towns.

If the Town decides to own the dam, then the SB should choose one of the following options:

1. Debt service and maintenance borne by the whole Town
2. Debt service and maintenance borne by a special tax district encompassing the shoreline property owners only (assessed either by average property value; pro rated according to property value; or pro rated according to shoreline frontage)
3. Debt service and maintenance borne by a special tax district encompassing shoreline owners plus a second special assessment tier – possibly a Maple Corner "village district" (boundary to be defined by King Solomon).
4. Debt service and maintenance borne by a combination of a special tax district encompassing the shoreline frontage owners and the Town at large. The SB shall choose and recommend to the voters an allocation within the range of Shoreline owners paying 80% of the cost and Town wide paying 20% of the cost through 50% shoreline owners and 50% town wide. (Section 1))

4 members favor option #4, 2 members favor option #1, and 1 member feels that any allocation formula should be solely for the SB to determine.

The TF notes that ANR suggested that the Town of Calais consider establishing a sinking fund for maintenance and future replacement of the dam in 75 years.

Other relevant issues that will aid in developing a policy.

WATER QUALITY

The subject of water quality of Curtis Pond was explored after the TF accepted and read through the Curtis Pond Watershed Survey – fall 2003. It is clear from that report that Curtis Pond is in the process of eutrophication due to past and present agricultural practices, septic systems, and road maintenance practices, along with the natural aging processes of such ponds. The TF discussed whether it is smart use of financial resources to repair the dam when the body of water it impounds is "dying." The committee decided that without a similar water quality report for each of the ponds in town, it is difficult to assess how relatively good or bad Curtis Pond's

condition is in comparison to the Town's other bodies of water. The TF unanimously recommended that the Town needs to address the following issues in order to maintain, and even improve, water quality at Curtis Pond and all other bodies of water in town.

- Proper road maintenance practices – ditching, etc.
- Policy regarding upgrading of seasonal dwellings to year round residences, since this upgrading increases the septic load of the CP watershed.
- Diligent enforcement of present septic and watershed regulations
- Adoption of improved and more vigorous septic regulations, particularly where systems may affect the Town's riparian resources. The Town may wish to consider regulations more stringent than the state mandated regulations which become effective in 2007.

OTHER CONSIDERATIONS

The TF listed and discussed at some length the various assets of the town's water resources in general and especially Curtis Pond. These bodies of water provide fishing, boating and water sports in the summer and ice fishing and skating in the winter. Each serves as a particular aesthetic and recreational component in its specific locale.

CURTIS POND DAM - MORRIS ROOT REBUILD OPTION

ESTIMATE OF POSSIBLE TAX CONSEQUENCES FOR $129,088 BOND REQUEST

Dam Repair Costs.....	$175,588.00
Amount on Hand (State & MCCC).....	($46,500.00)
Amount to be Bonded (20 years@ 4.5%)..	**$129,088.00**
Annual Debt Service (4.5%).....	$10,300.00
Annual Insurance & Ancillary Costs....	$2,300.00
TOTAL ANNUAL COST (20 YEARS)..	**$12,600.00**

Town Property is 1.0% of total appraised value of shoreline properties

Town Property is 7.4% of shoreline frontage.

				13-Jan-05	FINAL FOUR		Chart	
	Shoreline/Town - Cost Share % ->>	**100%-0%**	**90%-10%**	**80%-20%**	**70%-30%**	**60%-40%**	**50%-50%**	**0%-100%**
	AMOUNT **Shoreline** To Raise	$12,600.00	$11,340.00	$10,080.00	$8,820.00	$7,560.00	$6,300.00	
3 options for shoreline properties	**1.** Tax per $100,000 appraised value	$212.48	$191.23	$169.98	$148.73	$127.49	$106.24	
	2. Tax per 100 feet shoreline frontage	$87.56	$78.80	$70.05	$61.29	$52.54	$43.78	
	3. Flat Tax Per Parcel	$242.31	$218.08	$193.85	$169.62	$145.38	$121.15	
	AMOUNT **Town** to Raise	$0.00	$1,260.00	$2,520.00	$3,780.00	$5,040.00	$6,300.00	$12,600.00
	Tax on $100,000 appraised value	$0.00	$1.33	$2.65	$3.98	$5.31	$6.63	$13.26

1. Apply this rate to appraised value -> Some parcels have improvements (buildings), some don't, and some have property far removed from the pond.
2. Based on actual shoreline frontage -> Total frontage assumed to be 3 miles (15,840') per Curtis Pond Water Quality Report
3. Divide total by 52 -> Every parcel pays same.
   Total 55 parcels; 52 privately owned, 1 state owned, 2 town owned

CURTIS POND DAM - DuBOIS & KING CONCRETE REPLACE OPTION

ESTIMATE OF POSSIBLE TAX CONSEQUENCES FOR $181,544 BOND REQUEST

Dam Repair Costs.....	$228,044.00
Amount on Hand (State & MCCC).....	($46,500.00)
Amount to be Bonded (20 years@ 4.5%).	**$181,544.00**
Annual Debt Service (4.5%).....	$14,300.00
Annual Insurance & Ancillary Costs....	$2,300.00
TOTAL ANNUAL COST (20 YEARS)..	**$16,600.00**

Town Property is 1.0% of total appraised value of shoreline properties

Town Property is 7.4% of shoreline frontage.

			13-Jan-05	FINAL FOUR		Chart	
Shoreline/Town - Cost Share % ->>	**100%-0%**	**90%-10%**	**80%-20%**	**70%-30%**	**60%-40%**	**50%-50%**	**0%-100%**
AMOUNT **Shoreline** To Raise	$16,600.00	$14,940.00	$13,280.00	$11,620.00	$9,960.00	$8,300.00	
3 options for shoreline properties							
1. Tax per $100,000 appraised value	$279.93	$251.93	$223.94	$195.95	$167.96	$139.96	
2. Tax per 100 feet shoreline frontage	$115.36	$103.82	$92.29	$80.75	$69.21	$57.68	
3. Flat Tax Per Parcel	$319.23	$287.31	$255.38	$223.46	$191.54	$159.62	
AMOUNT **Town** to Raise	$0.00	$1,660.00	$3,320.00	$4,980.00	$6,640.00	$8,300.00	$16,600.00
Tax Rate / $100,000 appraised value	$0.00	$1.75	$3.49	$5.24	$6.99	$8.74	$17.47

1. Apply this rate to appraised value -> Some parcels have improvements (buildings), some don't, and some have property far removed from the pond.
2. Based on actual shoreline frontage -> Total frontage assumed to be 3 miles (15,840') per Curtis Pond Water Quality Report
3. Divide total by 52 -> Every parcel pays same.
   Total 55 parcels; 52 privately owned, 1 state owned, 2 town owned

CURTIS POND DAM $250,000 BOND REQUEST
ESTIMATE OF TAX CONSEQUENCES

Dam Repair Costs.....	$296,500.00
Amount on Hand (State & MCCC).....	$46,500.00
Amount to be Bonded (20 years@ 4.5%)	**$250,000.00**
Annual Debt Service (4.5%).....	$19,600.00
Annual Insurance & Ancillary Costs....	$2,300.00
TOTAL ANNUAL COST (20 YEARS)..	**$21,900.00**

Town Property is 1.0% of total appraised value of shoreline properties.

Town Property is 7.4% of shoreline frontage.

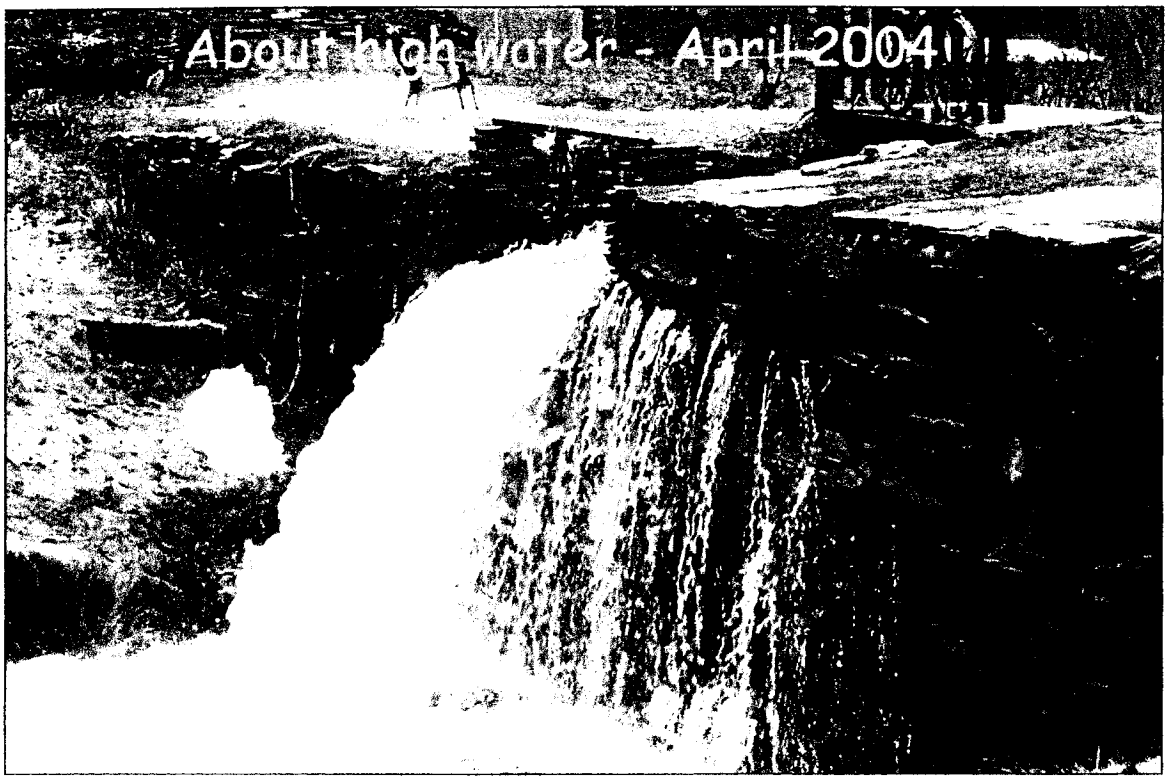
	13-Jan-05		FINAL FOUR			Chart	
Shoreline/Town - Cost Share % ->>	**100%-0%**	**90%-10%**	**80%-20%**	**70%-30%**	**60%-40%**	**50%-50%**	**0%-100%**
AMOUNT **Shoreline** To Raise	$21,900.00	$19,710.00	$17,520.00	$15,330.00	$13,140.00	$10,950.00	
3 options for shoreline properties							
1. Tax on $100,000 appraised value	$369.30	$332.37	$295.44	$258.51	$221.58	$184.65	
2. Tax per 100 feet shoreline frontage	$152.19	$136.97	$121.75	$106.53	$91.31	$76.09	
3. Flat Tax Per Parcel	$421.15	$379.04	$336.92	$294.81	$252.69	$210.58	
AMOUNT **Town** to Raise		$2,190.00	$4,380.00	$6,570.00	$8,760.00	$10,950.00	$21,900.00
Tax Rate / $100,000 appraised value		$2.31	$4.61	$6.92	$9.22	$11.53	$23.05

1. Apply this rate to appraised value -> Some parcels have improvements (buildings), some don't, and some have property far removed from the pond.
2. Based on actual shoreline frontage -> Total frontage assumed to be 3 miles (15,840') per Curtis Pond Water Quality Report
3. Divide total by 52 -> Every parcel pays same.

   Total 55 parcels; 52 privately owned, 1 state owned, 2 town owned

REPAIRS TO CURTIS POND DAM
CALAIS, VT

ALTERNATIVES APPRAISAL



Presented to Curtis Pond Dam Committee
Calais, VT

September 25, 2004

ROOT ENGINEERING
305 Summer Street
Springfield, VT

REPAIRS TO CURTIS POND DAM
CALAIS, VT

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REPAIRS TO CURTIS POND DAM
CALAIS, VT

General

Curtis Pond Dam is a stonewall-earth dam that is approximately 100 feet long and a maximum height of about 11 feet. The dam controls Curtis Pond, a surface area of 72 acres. The pond as shown by available mapping is 7 feet deep upstream of the dam at normal water level. The pool can rise about 2 feet before the entire dam is overtopped. The dam is classified as a "significant" hazard dam by the State of Vermont Department of Environmental Conservation. The significant hazard classification means the failure may (as opposed to "is likely to") cause loss of human life and damage homes, highways, or cause interruption of service of relatively important facilities. The relative impact on specific downstream locations has yet to be determined.

Recent inspections and investigations have found the following defects:

- Inadequate spillway capacity
- Lack of a functional low level outlet [pond drain]
- Seepage
- Reports of sinkholes and subsequent repair
- Displaced stone work

Root Engineering was retained by the Curtis Pond Dam Committee appointed by the Calais Board of Selectmen to evaluate options for repairing the dam. In discussion with the Committee, these alternates were considered:

1. The project proposed by DuBois & King in February 2004
2. Placement of stone fill downstream to abate any immediate perceived safety hazard
3. Remove the stone spillway and sluiceway, replace as a concrete structure with stoplogs, and install an upstream liner
4. Pressure grout the earth fill behind the existing stone wall
5. Reconstruction of the stone dam including backfill behind the stone wall.
6. Partial reconstruction of the existing dam.

Design criteria

In brief, the dam should be structurally stable, control seepage quantities, resist internal erosion [piping or creating sink holes], have adequate spillway capacity or be overtopped safely, and have a functioning low level outlet.

Part of the downstream stone wall has good vertical and horizontal alignment; however, the top of the wall on the eastern end has moved about 8" downstream. This appears to be the most significant indicator of structural instability. The movement reportedly was seen in the 1970's.

Seepage can be seen exiting the downstream face in an area between 6' west and 8' east of the spillway. It appears that a significant portion of the seepage is coming from the spillway as the stone joints have lost mortar and are allowing water to infiltrate the stone dam.

There is a report that a sinkhole was observed above the stone sluiceway, the plugged low level outlet. A neighbor placed about a cubic foot of concrete in the hole and placed earth fill above. Other than a couple of rodent holes, there were no holes observed in June 2004.

The spillway capacity has been judged to be inadequate as the dam may not withstand overtopping. If the stone wall were stable, other authorities report that a stonewall-earth dam can be overtopped by 6" to 1' frequently, about once in ten years, and experience only minor damage. The same report indicates infrequent major floods can safely overtop properly set capstones with depths of up to 4'. An option suggested in four of the following rehabilitation projects is the construction of a spillway 16' wide and 2' deep and raising the dam crest to a uniform elevation 1003, an increase of one half a foot. This would effectively contain the 100-year flood in the spillway. The 500-year flood would overtop the dam by 0.4 feet and the ½ PMF by 2.3 feet. This overtopping should be safe as long as the stone wall is stable.

The dam safety regulations require a low level outlet so that the water level in the pond may be drawn down for repairs or emergencies. On the other hand, the draw down recommended by the dam safety engineer may not be acceptable to the wetlands protection division. In fact, the cost estimates for the project alternatives acknowledge wetlands protection by budgeting for a cofferdam to maintain the pond water level during construction. The use of a pond drain is likely to be constrained to emergencies when the public good of reducing the potential of a dam failure outweighs the maintenance of water levels for wetlands or public recreation.

To be effective, at a minimum, a dam repair project needs to address these issues:

1. Relay the displaced stone wall to a stable configuration and provide backfill that is not frost susceptible.
2. Consider seepage sources and provide an impervious membrane; that is, concrete, impervious fill, or an impervious geomembrane.
3. Consider potential for internal erosion and provide material that can drain seepage and filter movement of fine soil.
4. Modify the spillway and stabilize the dam to minimize frequent overtopping and allow for moderate overtopping for infrequent flood events.
5. Provide for a low level outlet.

Alternatives

I. DuBois & King recommendation

This project proposes the construction of a concrete wall upstream of the existing dam. A low level outlet in the form of a 24-inch pipe controlled by a sluice gate will be laid through the dam. The stone work in the dam will be removed and replaced to allow the pipe to pass through and the stone spillway will be enlarged from a width of 6 feet to 10 feet. The concrete wall will be designed to be structurally stable for overtopping during major floods.

II. Stone fill downstream of the dam

Properly sized riprap would be dumped to buttress the dam. This would protect the dam from a sudden structural failure. Angular rock as used for rip rap is stable at a slope of 1.5 horizontal to

1 vertical. The project would require clearing the downstream area, dumping 250 cubic yards of stone covering roughly 1,300 square feet.

III. Concrete spillway and upstream high density polyethylene [HDPE] liner

This option has the following features:

1. Removing the stone spillway and stone sluiceway and construction of a concrete spillway 16' wide. The spillway would be equipped with stoplogs that could be removed to lower the water level.
2. Installation of an HDPE liner upstream of the dam embankment and placement filter drain material beneath it.
3. Reconstructing the stonework that has been displaced.

IV. Pressure grouting the earthfill

This option considers the use of a sand-cement grout injected into the dam to control the seepage. The quantity of grout has been estimated based on creating a concrete membrane 4 feet thick. In addition to the injection of the grout, a shallow concrete spillway, 16' wide by 2' deep would be built; and the displaced stonework restored. A low level outlet consisting of a 24-inch ductile iron pipe and gate valve would be installed prior to the pressure grouting of the structure.

V. Reconstruction of the stone dam

This alternative considers the rehabilitation of the existing structure. The old stone wall would be removed and rebuilt. The earth fill behind the stone wall excavated and a filter soil placed behind the stone wall and impervious fill placed upstream of the filter soil. A shallow, 16' wide by 2' deep, concrete spillway would be constructed. A low-level outlet consisting of a 24-inch ductile iron pipe and gate valve would be installed through the structure.

VI. Partial reconstruction of the stone dam

This alternative presumes that the major leakage source is the poorly maintained joints in the stone masonry spillway. Additional subsurface exploration is required during the design phase to better determine the nature of the soil behind the existing dam and more closely evaluate the water levels within the soil. If the existing soils are acceptable, the project would include an enlarged 16' wide by 2' deep concrete spillway; and restoration of the displaced stonework. A low level outlet consisting of a 24-inch ductile iron pipe and gate valve would be installed.

Estimates of Construction Cost and Total Project Cost

Individual spreadsheets with cost estimates follow. The Curtis Pond Dam Committee should consider these estimates and maintain adequate allowances for contingencies when developing the final budget for project funding. The following estimates of Construction Cost and Total Project Cost are made on the basis of Root Engineering's experience and qualifications and represent the best estimate as an experienced and qualified professional generally familiar with the construction industry. However, since Root Engineering has no control over the cost of labor, materials, equipment, or services furnished by others, or over contractors' methods of determining prices, or over competitive bidding or market conditions, Root Engineering cannot and does not guarantee that proposals, bids, or actual costs will not vary from the cost estimates.

I. NEW CONCRETE WALL UPSTREAM OF EXISTING DAM

ITEM	UNITS	QUANTITY	UNIT PRICE	COST
MOBILIZATION	LUMP SUM	1	$8,000.00	$8,000
CLEARING & GRUBBING DAM SITE	ACRE	1	$3,000.00	$3,000
DEWATERING & CONTROL OF WATER	LUMP SUM	1	$25,000.00	$25,000
DAM FOUNDATION PREPARATION				
PARTIAL EXCAVATION OF EARTH DAM	CUBIC YARDS	500	$5.00	$2,500
FOUNDATION EXCAVATION	CUBIC YARDS	20	$100.00	$2,000
PARTIAL REMOVAL OF STONE WALL	LUMP SUM	1	$2,500.00	$2,500
NEW CONCRETE WALL				
DRILL & GROUT REINFORCING BARS TO LEDGE FOUNDATION	EACH	40	$80.00	$3,200
SUB-FOOTING	CUBIC YARD	30	$400.00	$12,000
STRUCTURAL FOOTING	CUBIC YARD	60	$500.00	$30,000
STRUCTURAL WALL	CUBIC YARD	50	$600.00	$30,000
LOW LEVEL DUCTILE IRON PIPE	LINEAR FOOT	25	$100.00	$2,500
24-INCH SLUICE GATE	LUMP SUM	1	$7,500.00	$7,500
CIVIL/SITE COMPONENTS				
RECONSTRUCT STONE WALL	LUMP SUM	1	$2,500.00	$2,500
GRANULAR BACKFILL BEHIND CONCRETE WALL	CUBIC YARD	275	$20.00	$5,500
STONE FILL, TYPE II	CUBIC YARD	30	$40.00	$1,200
SEDIMENT & EROSION CONTROL MEASURES				
GEOTEXTILE SILT FENCE	SQUARE YARDS	100	$5.00	$500
TOPSOIL	CUBIC YARDS	40	$50.00	$2,000
GRUBBING MATERIAL	SQUARE YARDS	20	$35.00	$700
SEED	POUNDS	20	$15.00	$300
FERTILIZER	POUNDS	50	$5.00	$250
HAY MULCH	TONS	1	$785.00	$785
EROSION CONTROL MATTING	SQUARE YARDS	100	$5.00	$500

SUB-TOTAL	$142,435
25% CONTINGENCY	$35,609
CONSTRUCTION COST	$178,044
ENGINEERING & PERMITTING BUDGET	$28,000
CONSTRUCTION ENGINEERING	$22,000
TOTAL ESTIMATED PROJECT COST	$228,044

COSTS PER DUBOIS AND KING REPORT TO CURTIS POND DAM COMMITTEE, FEBRUARY 2004

Curtis Pond Dam
Calais, VT
Project Alternatives

II. STONE FILL

ITEM	UNITS	QUANTITY	UNIT PRICE	COST
MOBILIZATION	LUMP SUM	1	$1,500.00	$1,500
CLEAR TOE OF TREE(S)	LUMP SUM	1	$600.00	$600
DUMPED STONE FILL	CUBIC YARDS	245	$40.00	$9,800
			SUB-TOTAL	**$11,900**
			25% CONTINGENCY	$2,975
			CONSTRUCTION COST	**$14,875**
			ENGINEERING BUDGET	$2,000
			DAM PERMIT	$1,500
			STATE HISTORIC PROTECTION	$1,500
			CORPS OF ENGINEERS	$500
			TOTAL ENGINEERING & PERMITTING	**$5,500**
			CONSTRUCTION ENGINEERING	**$1,200**
			TOTAL ESTIMATED PROJECT COST	**$21,575**

III. CONCRETE SPILLWAY WITH UPSTREAM LINER

ITEM	UNITS	QUANTITY	UNIT PRICE	COST
MOBILIZATION	LUMP SUM	1	$8,000.00	$8,000
CLEARING & GRUBBING DAM SITE	ACRE	1	$3,000.00	$3,000
DEWATERING & CONTROL OF WATER	LUMP SUM	1	$25,000.00	$25,000
FOUNDATION PREPARATION				
EXCAVATE OLD SLUICEWAYS	CUBIC YARDS	231	$15.00	$3,467
PREPARE LEDGE	CUBIC YARDS	21	$100.00	$2,133
CONCRETE SPILLWAY				
CONCRETE WALLS	CUBIC YARDS	15	$450.00	$6,750
CONCRETE SLAB	CUBIC YARDS	19	$375.00	$7,125
EARTH BACKFILL	CUBIC YARDS	60	$20.00	$1,200
LINER INSTALLATION				
60 MIL HDPE LINER	SQUARE FEET	2300	$1.60	$3,680
EXCAVATE AND BACKFILL BEDDING	CUBIC YARDS	380	$20.00	$7,600
STONEWORK				
REMOVE AND RE-LAY DISPLACED STONES	SQUARE FEET	120	$60.00	$7,200
RAISE DAM TO ELEVATION 1003	SQUARE FEET	40	$30.00	$1,200
BACKFILL	CUBIC YARDS	18	$20.00	$356
SEDIMENT & EROSION CONTROL				
MISC. ITEMS	LUMP SUM	1	$5,000.00	$5,000
			SUB-TOTAL	$81,711
			25% CONTINGENCY	$20,428
			CONSTRUCTION COST	$102,138
			ENGINEERING AND PERMITTING BUDGET	$28,000
			CONSTRUCTION ENGINEERING	$15,000
			TOTAL ESTIMATED PROJECT COST	$145,138

IV. PRESSURE GROUT DAM STRUCTURE

ITEM	UNITS	QUANTITY	UNIT PRICE	COST
MOBILIZATION	LUMP SUM	1	$8,000.00	$8,000
CLEARING & GRUBBING DAM SITE	ACRE	1	$3,000.00	$3,000
DEWATERING & CONTROL OF WATER	LUMP SUM	1	$25,000.00	$25,000
PRESSURE GROUT	CUBIC YARDS	160	$725.00	$116,276
NEW SHALLOW SPILLWAY				
STRUCTURAL EXCAVATION	CUBIC YARDS	32	$100.00	$3,200
CONCRETE	CUBIC YARDS	14.6	$450.00	$6,570
LOW LEVEL OUTLET				
EXCAVATE & BACKFILL	CUBIC YARDS	160	$7.50	$1,200
24-INCH GATE VALVE	LUMP SUM	1	$5,000.00	$5,000
24-INCH DUCTILE IRON PIPE	LINEAR FOOT	25	$110.00	$2,750
STONEWORK				
REMOVE AND RE-LAY DISPLACED STONES	SQUARE FEET	120	$60.00	$7,200
RAISE DAM TO ELEVATION 1003	SQUARE FEET	40	$30.00	$1,200
BACKFILL	CUBIC YARDS	18	$20.00	$356
SEDIMENT & EROSION CONTROL				
MISC. ITEMS	LUMP SUM	1	$5,000.00	$5,000
			SUB-TOTAL	$184,751
			25% CONTINGENCY	$46,188
			CONSTRUCTION COST	$230,939
			ENGINEERING & PERMITTING BUDGET	$18,000
			CONSTRUCTION ENGINEERING	$15,000
			TOTAL ESTIMATED PROJECT COST	$263,939

V. REBUILD STONE DAM

ITEM	UNITS	QUANTITY	UNIT PRICE	COST
MOBILIZATION	LUMP SUM	1	$8,000.00	$8,000
CLEARING & GRUBBING DAM SITE	ACRE	1	$3,000.00	$3,000
DEWATERING & CONTROL OF WATER	LUMP SUM	1	$25,000.00	$25,000
STONEWORK				
REMOVE AND REBUILD EXISTING STONE FACE	LUMP SUM	1	$40,000.00	$40,000
EARTHWORK				
EXCAVATE AND BACKFILL FOR 3' GRAVEL COURSE BEHIND RETAINING WALL AND IMPERVIOUS FILL	CUBIC YARDS	690	$25.00	$17,250
GEOTEXTILE FACING ON STONE WORK	LUMP SUM	1	$1,500.00	$1,500
NEW SHALLOW SPILLWAY				
CONCRETE	CUBIC YARDS	14.6	$450.00	$6,570
LOW LEVEL OUTLET				
24-INCH DUCTILE IRON PIPE	LINEAR FOOT	25	$110.00	$2,750
24-INCH GATE VALVE	LUMP SUM	1	$5,000.00	$5,000
SEDIMENT & EROSION CONTROL				
MISC. ITEMS	LUMP SUM	1	$5,000.00	$5,000
			SUB-TOTAL	$114,070
			25% CONTINGENCY	$28,518
			CONSTRUCTION COST	$142,588
			ENGINEERING & PERMITTING BUDGET	$18,000
			CONSTRUCTION ENGINEERING	$15,000
			TOTAL ESTIMATED PROJECT COST	$175,588

Curtis Pond Dam
Calais, VT
Project Alternatives

VI. PARTIAL REBUILD DAM STRUCTURE

ITEM	UNITS	QUANTITY	UNIT PRICE	COST
MOBILIZATION	LUMP SUM	1	$3,000.00	$3,000
CLEARING & GRUBBING DAM SITE	ACRE	1	$3,000.00	$3,000
DEWATERING & CONTROL OF WATER	LUMP SUM	1	$25,000.00	$25,000
NEW SHALLOW SPILLWAY				
STRUCTURAL EXCAVATION	CUBIC YARDS	32	$100.00	$3,200
CONCRETE	CUBIC YARDS	14.6	$450.00	$6,570
LOW LEVEL OUTLET				
EXCAVATE & BACKFILL	CUBIC YARDS	160	$20.00	$3,200
24-INCH GATE VALVE	LUMP SUM	1	$5,000.00	$5,000
24-INCH DUCTILE IRON PIPE	LINEAR FOOT	25	$110.00	$2,750
STONEWORK				
REMOVE AND RE-LAY DISPLACED STONES	SQUARE FEET	120	$60.00	$7,200
RAISE DAM TO ELEVATION 1003	SQUARE FEET	40	$30.00	$1,200
EXCAVATE & FILL	CUBIC YARDS	18	$20.00	$356
SEDIMENT & EROSION CONTROL				
MISC. ITEMS	LUMP SUM	1	$2,500.00	$2,500
			SUB-TOTAL	$62,976
			15% CONTINGENCY	$9,446
			CONSTRUCTION COST	$72,422
			ENGINEERING & PERMITTING BUDGET	$20,000
			CONSTRUCTION ENGINEERING	$12,000
			TOTAL ESTIMATED PROJECT COST	$104,422

Project Evaluation Matrix

This table outlines projects, cost estimates, site aesthetics, cultural resources, environmental permits, dam permit, and expected long term performance based on structural stability, seepage control and protection against internal erosion, and spillway adequacy.

Project	Cost Estimate	Aesthetic Impact	Cultural Resource	Environmental Permits	Dam Permit	Long term performance	Durability
II. Downstream stone fill	$21,500	Downstream face covered with riprap	Fill subject to review by SHPO	Impact area less than 3,500 square feet – should not require CUD or USACOE review.	Required, structural alteration.	Leakage through dam cause water level to drop in future.	Poor, water level may drop in future.
VI. Partial reconstruction	$104,000	18' by 2' spillway added, disturb stone wall to install outlet, raise dam ½'	Alteration of structure subject to review by SHPO	No Conditional Use Determination or Corps of Engineers, if wetlands are unaltered.	Required	Stone wall stabilized. Overtopping infrequent. Piping control an issue.	Fair to good, depends on performance of existing soil. Repair on 10 year cycles.
III. New concrete spillway and upstream HDPE liner	$145,000	18' of stone dam removed	Alteration of structure subject to review by SHPO	No Conditional Use Determination or Corps of Engineers, if wetlands are unaltered & fill within existing footprint.	Required	Stone walls stabilized. Overtopping infrequent. HDPE liner is weak link.	Fair to good, liner repair possible. Life about 25 years.
V. Rebuild dam	$176,000	Stone preserved. Appearance altered not stone by stone reconstruction. 18' by 2' spillway and outlet added, raise dam ½'	Construction plans and contractors credentials subject to review by SHPO	No Conditional Use Determination or Corps of Engineers, if wetlands are unaltered & fill within existing footprint.	Required	Stone wall stabilized. Overtopping infrequent. Earth-fill rebuilt.	Excellent, maintain pond water level.
I. Concrete wall dam	$228,000	Disturb stone wall to install outlet pipe	Minor change to spillway, wall disturbance subject to review by State Historic Protection Office [SHPO]	No Conditional Use Determination or Corps of Engineers, if wetlands are unaltered & fill within existing footprint.	Required	Concrete wall will remain and retain pond. Stone dam subject to degradation.	Excellent, maintain pond water level.
IV. Pressure grout existing earth fill	$264,000	18' by 2' spillway added, disturb stone wall to install outlet, raise dam ½'	Alteration of structure subject to review by SHPO	No Conditional Use Determination or Corps of Engineers, if wetlands are unaltered & fill within existing footprint.	Required	Stone wall stabilized. Overtopping infrequent. Potential for grout rework.	Fair to good, grout subject to subsurface anomalies. 50 year life.

Annual Maintenance

With any structure, there is annual maintenance. However, in the case of the options reviewed, the choice of stone fill is similar to abandonment, requiring no future maintenance.

It is assumed that any alternative would be constructed in accordance with approved plans and specifications and proper engineering observation.

The construction of the concrete wall or the reconstruction of the stone dam would be similar in annual maintenance demands. The concrete wall project does not propose significant stone wall construction. Repair work of the stone masonry would be at the discretion of the dam owner in keeping with maintenance of aesthetic value of the dam. On the other hand, the restored stone dam approach would replace the stone work and properly constructed backfill. This alternative would be overtopped infrequently; that is, on the average of once in a 100-years. The maintenance would be limited to cutting grass and removing woody vegetation.

The use of pressure grout, the high density polyethylene [HDPE] liner, or partial reconstruction require repair. All alternatives can be successful under proper conditions. On the other hand, pressure grout can be subject to subsurface anomalies and not complete a seal. Liners have been known to rupture and need repair. In addition, liner technology is relatively recent and the product life expectancy is unproven. The useful service life of the liner is estimated to be 25 years. Repair costs for pressure grout or HDPE liner are likely to be about the same. Pressure grout when completely sealed is expected to last more than twice as long as the HDPE liner. Partial reconstruction would be acceptable providing soil exploration and analysis indicate the existing fill is reliable. If the fill is shown to be adequately dense, the risk of the HDPE liner failing is reduced significantly. As a precautionary measure, the partial reconstruction approach should consider the potential need for repair to the earth fill on about a 10 year cycle.

Environmental Permits

The regulatory permits identified in the above table would dominate the construction project, but do not represent a comprehensive list. Depending upon the entity owning the dam, Act 250 review may be required. In addition, there are permits governing removal and disposal of inert construction debris, sediment and erosion control, and shoreline structures to name a few. Most water quality issues have been reviewed under the dam permit umbrella in the past. The project proponent should review the chosen alternative with the local permits' specialist at the District Environmental Commission to confirm the project permit requirements.

Conclusion

Options for rehabilitating the Curtis Pond Dam range in estimated cost from about $100,000 to more than $250,000. There needs to be more evaluation of the fill soils and a more complete understanding of wetland protection and sediment management issues prior to choosing the less expensive options. These options rely on the adequacy of existing fill soils. In addition, partial reconstruction may require more frequent

maintenance. The suitability of this option would be judged after meeting with the Agency of Natural Resources to assess the concerns of wetland protection, sediment and erosion control, along with dam safety. Infrequent, properly managed, short-term draw downs for dam maintenance might be acceptable. If not, the recurring expense of cofferdams may make the partial reconstruction cost prohibitive

I. INTRODUCTION

The purpose of this study is to identify and evaluate existing deficiencies at the Curtis Pond Dam. This study also includes the preparation of an Emergency Action Plan (EAP) and the evaluation of a new concrete wall, within the intended function of reinforcing the existing dam to retain the pond. The dam is currently privately owned, and there is currently ongoing discussions regarding the future owner status.

The Curtis Pond Dam Committee (Committee) was formed to advance the evaluation of the dam on behalf of the dam owner. The Committee retained the professional services of DuBois & King, Inc., (D&K) a consulting engineering firm in Randolph, Vermont, to assist with the development of this evaluation and prepare the engineering report.

DuBois & King's primary role is to lead the investigation into the condition of the dam, to develop the EAP and to develop a conceptual design of a new concrete wall. Jeffrey W. Tucker, P.E., Vice President, is the Senior Dam Engineer and primary author of this report on behalf of DuBois & King. The Vermont Department of Environmental Conservation, Dam Safety Section (Dam Safety) is providing technical oversight to this project.

The primary goals and objectives for this project are summarized below:

1. **Identify and quantify the existing condition of the dam, including deficiencies.**

2. **Evaluate the feasibility of a New Concrete Wall to correct the deficiencies**

3. **Prepare an Emergency Action Plan for use in the event of a dam failure.**

Background

Curtis Pond is located in the Town of Calais, Washington County, Vermont. Historically, there were 2 smaller, separate ponds prior to the dam being constructed. When the dam was constructed circa 1900, the water level in the brook was raised approximately 10-feet. This additional depth inundated both ponds, creating the 72-acre body of water that exists today.

The volume of water impounded by the dam is approximately 724-acre-feet, at the normal water level, and increases to approximately 1,000 acre-feet at the top of the dam. Because the dam impounds more than 11.5 acre-feet, it falls under the regulatory jurisdiction of the Vermont Department of Environmental Conservation, Dam Safety Section (Department), under the provisions of 10 VSA, Chapter 43 Dams.

The dam was originally constructed around 1900, and is located near the southeastern corner of the pond. The structure consists of a laid up masonry stone on the downstream face, which supports a sand and gravel embankment. The maximum height is approximately 11-feet and its length is approximately 120-feet. The Hazard Classification of this dam is currently Significant, as defined by Department Guidelines.

Recent Dam Safety Reports prepared by the Department, state that the dam is considered to be in poor condition. This condition is defined by a number of parameters, including inadequate hydraulic spillway capacity, active piping of backfill through the stonewall, uncontrolled seepage through the dam, an inoperable low-level drain and movement of the stones.

Description of Dam and Watershed

The Curtis Pond drainage area is approximately 884 acres (1.38 square miles) in size and is part of the Pekin Brook Watershed, which is a tributary of the Kingsbury Branch of the Winooski River. The drainage area is predominately rural and undeveloped, with a majority of the current land use consisting of pasture and woodland. Topographic relief is relatively mild in the lower portions of the watershed and very steep in the upper reaches. A detailed hydrologic analysis of the watershed was conducted as part of this project and the results are presented later in this report.

The Department's Agency Facilities Division conducted a topographic survey of Curtis Pond Dam in May 2003 and provided it to DuBois & King for use with this study. Horizontal control was based on ground control points established at the time of the survey. Vertical control was an assumed local datum. An existing condition base map of the dam and adjacent area was prepared following the topographic survey. A copy of the base map is appended to this report.

Engineering Study and Evaluation

For the Rehabilitation of Curtis Pond Dam

Prepared for the

The Curtis Pond Dam Committee

Prepared by:

DuBois & King inc.

January 30, 2004

State of Vermont AGENCY OF NATURAL RESOURCES
Department of Environmental Conservation
Facilities Engineering Division
103 South Main Street
Waterbury, VT 05671-0406

Phone: 802-241-3450
Fax: 802-241-3273

May 14, 2003

Mr. Paul Hannan
Calais, VT 056

RE: Dam Inventory for the Town of Calais

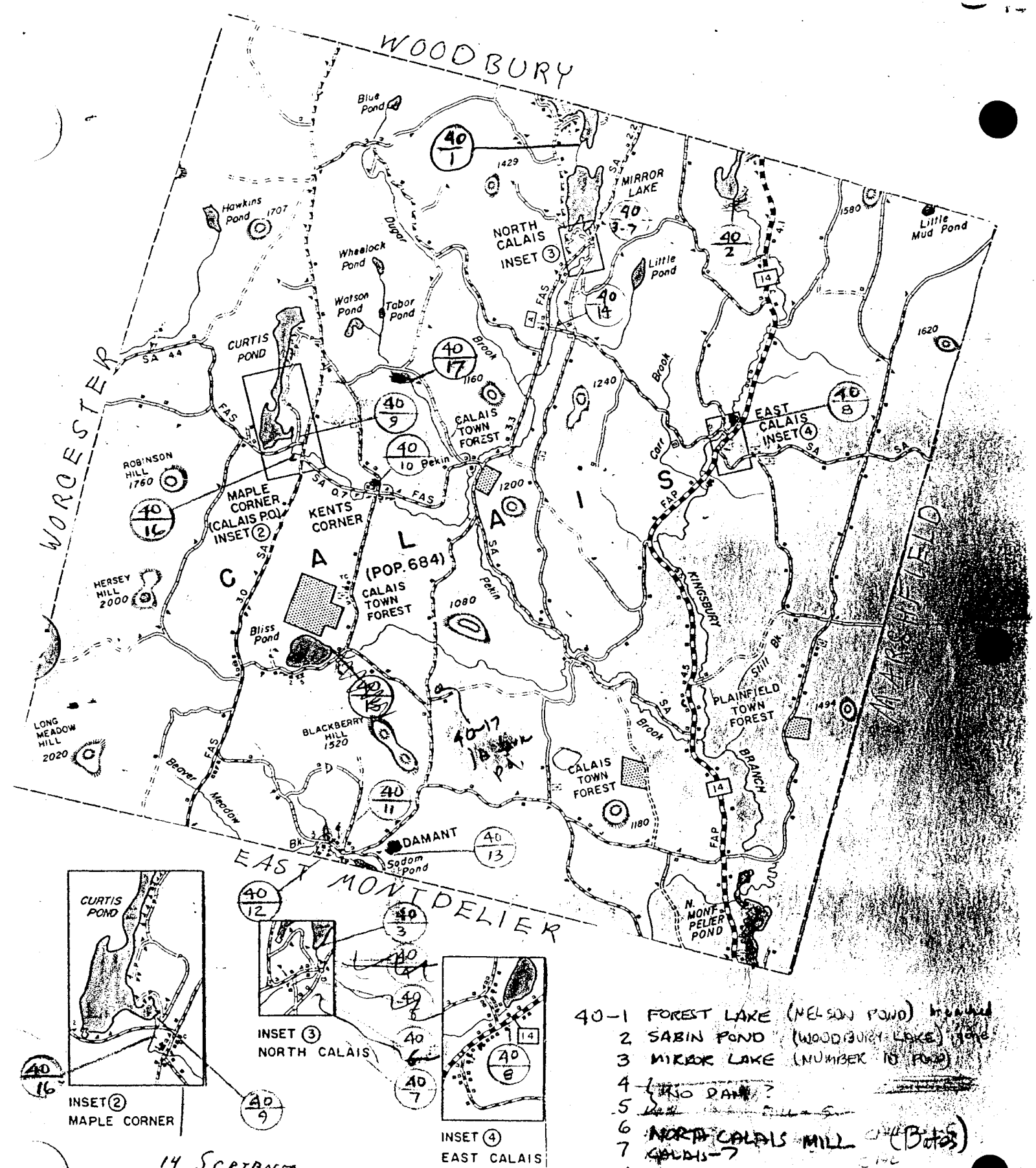
Dear Mr. Hannan:

Per your request, attached are the information sheets and an inventory map of the dams located in the Town of Calais. Please note that only those dams included in the State of Vermont Dam Inventory database are listed, therefore it may not include every dam in the Town.

A brief summary of the dams, based on inventory data, follows:

Dam Name/Number	AKA	Listed Owner	Hazard Class	Last Inspection Date
Adament Pond/40-11	Upper Sodom Pond	Frank Suchomel Jr.	2	7/15/88
Curtis Pond/40-9		Beardsley/Fothergill	2	7/14/03
Elmslie/40-17		K. Elmslie	2	11/14/89
Mirror Lake/40-3	Number 10 Pond	Curtis Johnson	2	9/1/87
E. Calais Mill/40-8	Moscow Mills	John Risse	3	8/9/89
Maple Corners/40-16	Mill Pond	Unknown	3	5/2/79
Rogers/40-13		H and B Weedon	3	8/7/79
Calais-7/40-7		Unknown	Not determined	None listed
Hatch's Mill/40-12		Unknown	Not determined	None listed
Nelson Pond/40-1	Forest Lake	Unknown	Not determined	None listed
N. Calais Mill/40-6	Bates	Unknown	Not determined	None listed
Robinsons Sawmill/40-10	Kent Corners	Aldrich Memorial Association	Not determined	None listed
Sabin Pond/40-2	Woodbury LK	Unknown	Not determined	None listed
Scribner/40-14		Unknown	Not determined	None listed

There are 14 dams listed. Curtis Pond is monitored monthly and had a complete inspection in 2003,



40-1 FOREST LAKE (NELSON POND) [illegible]
2 SABIN POND (WOODBURY LAKE) [illegible]
3 MIRROR LAKE (NUMBER 10 POND)
4 [illegible] DAM ?
5 [illegible]
6 NORTH CALAIS MILL (Bates)
7 CALAIS-7
8 EAST CALAIS MILL
9 CURTIS POND
10 ROBINSONS SAW MILL (KENTS CORNER)
11 ADAMANT POND
12 HATCH'S MILL
13 ROGERS

14 SCRIBNER
40-15 BLISS POND dam? natural outlet
16 MILL POND (breached)
17 ELMSLIE
18 ADAMANT POND DAM

The following is a summary of existing dam geometric data:

State Identification Number:	Department of Environmental Conservation No. 40.09	
Drainage Area:	Size: 1.38 square miles Type: Pasture and woodland with moderately steep to very steep sloping terrain.	
Elevations (feet, assumed):	Top of Dam	1002.5 (average)
	Spillway Invert	1001.0
	Stream bed at base of dam	991.7
Lake Surface Area (acres):	Top of dam	75 acres
	Spillway Invert	72 acres
Lake Storage (acre-feet):	Top of dam	1,000 ac-ft
	Spillway Invert, Water Level	724 ac-ft
Dam:	Type:	Sand / Gravel with Laid Up Stone Wall
	Overall Length:	120 feet
	Height:	10.8 feet at maximum section
	Top width:	17.1-feet
	Side Slopes:	1V: 3 H upstream slope Vertical downstream slope
Spillways:	Primary Spillway:	5.8 -foot length fixed weir sluiceway
	Auxiliary Spillway:	None
	Emergency Spillway:	None

Table 5
Hazard Potential Classification

ASACE ER-1110-2-106, Table 2 **HAZARD POTENTIAL CLASSIFICATION**		
Category	**Loss of Life (Extent of Development)**	**Economic Loss (Extent of Development)**
Low	None Expected (No permanent structures for human habitation)	Minimal (Undeveloped to occasional structures or agricultural)
Significant	Few (No urban development and no more than a small number of inhabitable structures)	Appreciable (Notable, agriculture, industry, or structures)
High	More than a few	Excessive (Extensive community, industry, or agriculture)

V. SUMMARY OF DEFICIENCIES

A number of deficiencies of the dam have been identified as a result of this engineering analysis and are summarized below.

Inadequate Spillway Hydraulic Capacity

As indicated above, the dam is subject to overtopping during the 25-year storm event. Dam safety design standards indicate that a dam spillway hydraulic capacity for a SIGNIFICANT hazard classification dam should be able to safely pass the ½ Probable Maximum Precipitation event.

The dam is expected to be overtopped by approximately 2.8-feet during the ½ PMP (see Table 1, page 8). The existing stone dam is not expected to be stable at this level of overtopping. The probable mode of failure of the walls would be erosion and washout. A complete failure of the dam would be expected.

However, there is no practical way to pass a ½ PMP event without overtopping the dam unless it is completely rebuilt with a massive spillway, which is not warranted given the setting of this site. It is DuBois & King's professional opinion that the dam should be capable of safely passing the 500-year storm event.

Seepage Through the Embankment

There is significant seepage occurring through the dam. Because there is no seepage control (mineral filter), there is a high probability of transport of fines through the sand /

soil backfill. Indeed, sinkholes have developed along the upstream crest of the dam, suggesting that active piping is occurring. Under existing conditions, the dam is vulnerable to a piping failure (fines through the embankment).

Inoperable Low-level Outlet

The existing low-level outlet, which can be seen as the 2-foot square opening in the stonewall, does not work. The location of the inlet to this opening is not known, and is probably buried under the embankment. Siphons and pumping are the only available methods of lowering the pond water level. It is very important to have the ability to lower the pond for repair or emergency situations.

VI. NEW CONCRETE WALL

There has been significant discussion over the recent years on how to best repair and stabilize Curtis Pond Dam. One alternative that has been identified is a new concrete wall. The wall would be constructed along the upstream edge of the existing dam, along the edge of the pond. The existing stone dam would remain in place, and the new concrete wall dam would be designed to carry the hydrostatic pressures of a significant storm event.

The new concrete wall would be overtopped during a 50-year or greater storm event. However, the wall would be designed to remain stable to at least the 100-year storm, and therefore Curtis Pond would not breach. The existing stone dam would remain vulnerable to washout, but even if it failed, the new concrete wall would not, and therefore a breach would not occur.

DuBois & King has designed a number of similar, new concrete wall repairs to dams. The advantage of a new concrete wall include minor impacts to the area (as opposed to remove and replace), relatively low cost, minor environmental impacts, ease of construction and retainage of the historic stone dam.

The new concrete wall would be pinned directly to ledge. This will significantly reduce seepage through the dam, which will prolong the service life of the existing stone dam. It will also significantly reduce the potential for piping of fines, as the concrete wall would provide a near impervious barrier for the movement of fines. The results of the subsurface investigation indicate that ledge is relatively shallow below grade. Therefore, a new concrete wall will not be very tall, nor significantly expensive.

DuBois & King has conducted a construction cost estimate for a new concrete wall. We have performed a conceptual level design of the wall and have estimated the required geometry, such as wall and footing depth and width. The construction quantities have been identified and measured. The unit prices of the construction quantities have been estimated using recent similar projects. A summary construction cost estimate has been prepared and is summarized on a spreadsheet, which is appended to this report.

The total project costs for this project has been estimated by combining the construction costs with the cost of a temporary dam, the costs to conduct engineering, to prepare construction documents, to obtain the environmental permits and to oversee construction. The total project costs are $228,044, which includes the construction cost of $178,044.

It is expected that a temporary dam would be installed immediately upstream of the existing dam. This will allow Curtis Pond to remain full, or nearly full during construction. Retainage of the pond will allow for use by the public as well as protecting wildlife habitat and wetlands.

VII. SUMMARY AND RECOMMENDATIONS

The existing Curtis Pond Dam has been and continues to deteriorate. It is considered to be in poor condition for a number of reasons, including movement of the stones, excessive seepage, piping and active sinkholes, inadequate hydraulic capacity and a inoperable low level drain.

Collectively, these deficiencies represent a progressive deterioration of the dam and suggest that its structural integrity and associated safety continue to decline. This condition provides justification to identify and evaluate alternatives to create a permanent and low maintenance structure and to plan for the implementation of a preferred alternative.

DuBois & King Inc. recommends construction of a new concrete dam wall to be installed along the upstream edge of the existing dam. This alternative meets the goals and objectives of creating a safe, low cost and low maintenance dam.

The Vermont Statutes Online

Title 24: Municipal and County Government

Chapter 87: SPECIAL ASSESSMENTS

24 V.S.A. § 3251. Definitions

§ 3251. Definitions

As used in this chapter:

(1) "Legislative body" means "legislative body" as defined in section 2001 of this title.

(2) "Property" means real estate.

(3) "Sewage system" means "sewage system" as defined in section 3501 (6) of this title.

(4) "Special assessment" means a tax assessed against one or more properties receiving the benefit of a particular public improvement, as distinguished from a tax on the entire grand list of a municipality.

(5) "Water system" means "water system" as defined in section 3341(b)(2) of this title without reference to any determination by the water commission. (Added 1969, No. 170 (Adj. Sess.), § 10, eff. March 2, 1970.)

24 V.S.A. § 3252. Purpose of assessments

§ 3252. Purpose of assessments

Special assessments may be made for the purchase, construction, repair, reconstruction or extension of a water system or sewage system, or any other public improvement which is of benefit to a limited area of a municipality to be served by the improvement. (Added 1969, No. 170 (Adj. Sess.), § 10, eff. March 2, 1970.)

24 V.S.A. § 3253. Method of apportionment

§ 3253. Method of apportionment

A special assessment may be apportioned among the properties to be benefited thereby according to the listed value of such properties in the grand list, the frontage thereof, the added value accruing to

each property by reason of the public improvement for which such assessment is made, or by any method other than the foregoing which results in a fair apportionment of the cost of the improvement in accordance with the benefits received. (Added 1969, No. 170 (Adj. Sess.), § 10, eff. March 2, 1970.)

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24 V.S.A. § 3254. Approval of voters

§ 3254. Approval of voters

A special assessment under this chapter shall be levied only by vote of a majority of the qualified voters of the municipality voting at an annual or special meeting duly warned for that purpose. However, the question need not be submitted to the voters if all of the owners of record of property to be assessed, or of any interest therein, other than mortgagees or lien holders, consent in writing to the assessment. Either the vote or the consent shall include approval of the method of apportionment of the assessment. (Added 1969, No. 170 (Adj. Sess.), § 10, eff. March 2, 1970.)

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24 V.S.A. § 3255. Collection of assessments; liens

§ 3255. Collection of assessments; liens

Special assessments under this chapter shall constitute a lien on the property against which the assessment is made in the same manner and to the same extent as taxes assessed on the grand list of a municipality, and all procedures and remedies for the collection of taxes shall apply to special assessments. (Added 1969, No. 170 (Adj. Sess.), § 10, eff. March 2, 1970.)

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24 V.S.A. § 3256. Construction with other laws

§ 3256. Construction with other laws

Nothing contained in this chapter shall prohibit the financing of any of the improvements referred to in this chapter by a tax on the grand list of a municipality, or by other means. (Added 1969, No. 170 (Adj. Sess.), § 10, eff. March 2, 1970.)

PERTINENT DOCUMENTS

The following documents have been presented and accepted into the town records prior to the formation of the Task Force. All are on file and available at the Town Clerk's Office.

- Curtis Pond Dam Construction Project – October 2003
- Curtis Pond Watershed Survey – Fall 2003
- DuBois and King Concrete Option – January 2004 - unabridged
- Emergency Action Plan – February 2004
- State Dam Inventory for the Town of Calais – May 2004